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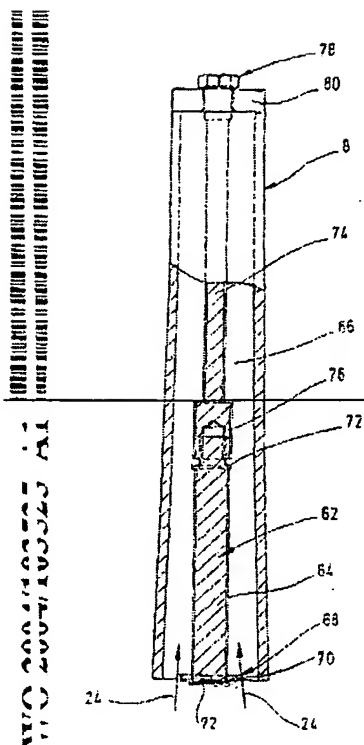
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FILTER ELEMENT



(57) Abstract: The invention relates to a filter element (8), especially for use in back-wash filtering systems, which comprises a filtering element through which a contaminated fluid flows in at least one direction (24). An intercepting device (62) comprises at least one rod-shaped permanent magnet or solenoid (64) that at least partially removes magnetizable, especially ferritic portions from the fluid before the latter flows through the filtering element. A detaching device (68) removes the above-mentioned portions from the intercepting device (62). The detaching device (68) is configured by a stripper ring (70) that travels along the rod-shaped magnet (64) and removes the portions retained by the intercepting device (62). When the filtering element is backwashed, the stripper ring (70), moved by the fluid flow, detaches the portions retained by the intercepting device (62). The inventive element requires little construction space and allows for the automatic and energetically favorable removal of magnetizable, especially ferritic portions when the filtering element is backwashed.

(57) Zusammenfassung: Die Erfindung betrifft ein Filterelement (8), insbesondere für den Einsatz bei Rückspülfiltervorrichtungen, mit einem Filtrationsteil, das zumindest in einer Richtung (24) von einem Verschmutzungen aufweisenden Fluid durchströmbar ist, wobei eine Abfangeinrichtung (62) vorhanden ist, die mindestens einen stabförmigen Permanent- oder Elektromagneten (64) aufweist, der magnetisierbare, insbesondere ferritische Anteile zumindest teilweise aus dem Fluid entfernt bevor dieses durch das Filtrationsteil strömt, wobei eine Ablöseeinrichtung (68) vorhanden ist zum Entfernen der genannten Anteile von der Abfangeinrichtung (62). Dadurch dass die Ablöseeinrichtung (68) aus einem Abstreifring (70) gebildet ist, der entlang des stabförmigen Magneten (64) verfahrbar die Entfernung der von der Abfangeinrichtung (62) festgehaltenen Anteile vornimmt und dass beim Rückspülen des Filtrationsteils der Abstreifring (70) vom Fluidstrom bewegt die Ablösung der an der Abfangeinrichtung (62) festgelegten Anteile vornimmt, wird mit kleinen Bauabmessungen und energetisch günstig der Austrag von magnetisierbaren, insbesondere ferritischen Anteilen automatisch bei einem Rückspülvorgang eines Filterelementes veranlasst.

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## Filter Element

The ~~invention~~present invention relates to a filter element, especially for use in backflush filter devices, with a filtration part through which a fluid which has contaminants can flow at least in one direction,~~there being a~~. A capture device ~~which~~ has at least one rod-like permanent magnet or electromagnet, which removes magnetizable, especially ferritic portions, at least partially from the fluid before it flows through the filtration part,~~there being a stripping means for removal of the~~. A stripper removes the indicated portions from the capture device.

### Background of the Invention

EP-0 968 039 B1 discloses a backflush filter device for use of slotted hole screen tubular filter elements which can be accommodated in a housing with a filter inlet and an outlet for the fluid to be filtered,~~flow~~. Flow through the filter elements for filtration or backflushing ~~being~~is possible in both directions,~~and for~~. For backflushing ~~there being~~, a drivable flushing arm ~~which~~ has a fluid outlet for fouled fluid and ~~which~~ can be moved in succession under the flow cross sections of the filter elements. In the known solution, at least some of the inserted slotted hole screen tubular filter elements ~~which are used~~ are made conical,~~the~~. The structural length of the conical filter elements ~~being~~is at least ten times greater than the largest existing passage cross section for the fluid,~~the~~. The distance between the individual conical slotted hole screen tubular filter elements or between them and the cylindrical ones in the direction of their free ends is enlarged, with the result that the outflow space in the filter housing is enlarged, and moreover the escape resistance in filter operation is lowered. During backflushing, the conical slotted hole screen tube filter element presents a clear advantage over the cylindrical one, primarily due to the relatively larger exit cross section of the conical filter elements compared to the cylindrical ones for the same filter surface ~~being the cause of this. But since~~. Since the exit cross section for the

conical filter elements is comparatively small relative to the entry cross section formed by the filter surface, that is, the free element surface, depending on the magnitude of the flow resistance of the slotted tube, a bottleneck forms in ~~which~~ a large part of the system pressure drops off. Therefore, in the known solution small pressure losses occur; ~~this has,~~ having a beneficial effect in terms of energy during backflushing.

During backflushing a large part of the volumetric throughput for conical and cylindrical filter elements is achieved fundamentally on the lower filter end ~~and the~~. The volumetric flows decrease very quickly. ~~Since the~~ The conical element is backflushed much farther, ~~in addition,~~ Also, the velocity gradient is less, ~~so that with,~~ With incorporation of the velocity profiles relative to the filter surface ~~there is,~~ an additional cleaning effect compared to cylindrical elements due to the conicity of the element: is caused. This additional cleaning effect takes place carefully due to the essentially constant velocity attained when the conical filter elements are being cleaned off; ~~this prolongs,~~ prolonging the service life of these filter elements.

DE 40 30 084 A1 discloses a backflushing device ~~which~~ can be backflushed with the dirty liquid ~~which~~ is to be filtered, preferably in counterflow to the filtering direction. The known solution in the filter housing has a plurality of filter cells in a circular configuration ~~which~~ can be connected to the sludge discharge using a flushing arm ~~which is~~ driven by a rotary drive individually or in small groups for backflushing. Although, in the known configuration in the backflushing process, the dirty liquid flows through the filter cells with a high turbulent velocity in the longitudinal direction and in the process dissolves and removes the deposited contaminants, the filtering and backflushing result can be improved. Since the filter elements are made cylindrical, they are located tightly next to one another in the filter housing and the free discharge space in the filter housing is accordingly small, ~~so that in.~~ In normal filter operation, the outflow resistance for the filtered fluid is then increased by the mutual influence of the cylindrical filter elements on one another, ~~and accordingly.~~ Accordingly, the pressure difference between the filter

inlet and outlet is also increased. ~~But this leads,~~ leading to an altogether poor energy balance in the described known solution.

Even if, as described in DE 83 06 970 U, the cylindrical filter elements are located at a clear distance from one another within the filter housing, especially during backflushing of these cylindrical filter elements a nonuniform fluid flow results, with the consequence that the fluid speed continuously increases within the cylindrical elements; ~~this.~~ This fluid flow likewise adversely affects the energy balance of the entire backflushing device.

DE 38 12 876 A1 discloses a conical filter element ~~which is used~~ for filtering and separating different substances and particles; ~~a.~~ A conically wound wire in the form of a helix or a helical cone ~~being is~~ is routed within support rods ~~which run~~ onto one another. The penetrated conical construction in which the length-width ratio is in the range of 1 produces a type of funnel effect ~~which is intended~~ to enhance the separation performance. Even if the pertinent conical filtering and separating element were used in a backflushing device, in any case a larger exit cross section for the fluid relative to the entry cross section formed by the filter surface would not be achieved ~~and thus.~~ Thus, increased flow resistances arise ~~which adversely affect~~ the efficiency during backflushing. A device comparable to this arrangement is also disclosed by U.S.A. Patent No. 2,237,964.

When the conical or cylindrical filter elements according to the above described prior art and the pertinent backflushing devices are used for filtration tasks, in ~~which~~ ferritic portions can be found as contaminants in the fluid flow to a high degree, ~~which is~~ for example often the case in cooling lubricant fluids ~~which are~~ to be filtered, the described known solutions however reach their performance limits. They do filter the ferritic portions out of the fluid flow; ~~the.~~ The free filter pores of the respective filtration material used however quickly clog with the ferritic portions so that soon the filtration part of the respective filter element is blocked, regardless of whether it is made conical or cylindrical. Even if these filter elements are then used in backflushing filter

devices in which ~~there is the possibility of counterflushing the respective filter element in the opposite throughflow direction from the clean side to clean off the filtration part, on the one hand~~ is possible, the pertinent cleaning processes must then be undertaken exceptionally often; ~~this~~. This requirement adversely affects the filtration performance of the respective device. On the other hand, agglutination or caking of the ferritic portions with the filter material of the filtration part often occurs ~~so that in this respect during~~. During backflushing, the ferritic contamination may also then remain joined to other contaminant portions in the filtration part, or damage to the filtration part occurs during backflushing, especially on its filtration layer or the slotted hole screen tube material of the filter element.

FR-2 718 065 A1 discloses a generic filter element ~~which~~ removes contaminants from the fluid as throughflow proceeds from the inside to the outside. In the filter element with its cylindrical mat structure, there are two rod-shaped permanent magnets which trap magnetizable, especially ferritic portions, out of the fluid as it flows through the filter element. ~~In order to~~ To remove the captured ferritic portions from the rod-like permanent magnets, ~~as the stripping means there is a stripping plate which encloses the rod-like permanent magnets on the outer circumferential side and which is configured to be able to move within the filter element space by means of a hydraulic or pneumatic cylinder, and effects to clean-off in the direction of motion from top to bottom in the position of use of the filter element, the~~. The discharge of the ferritic portions ~~taking takes~~ place on the bottom of the filtration part ~~which is held in the housing~~. After clean-off in the form of stripping, the working cylinder resets the stripping plate back into its initial or rest position above the actual filter element so that the known solution, especially due to use of the working cylinder, is designed to not only be geometrically large in the axial direction, but also requires additional energy for cleaning or stripping during operation of the respective working cylinder.

— On the basis of this prior art the Summary of the Invention

\_\_\_\_\_ An object of the present invention is to ~~further improve known~~ provide improved filter element designs, especially ~~also those~~ intended for use in backflushing filter devices, such that when magnetizable, especially ferritic portions, occur in the fluid flow ~~which is to be filtered~~, the described disadvantages, especially devices with ~~a not overly large structure which require structures and requiring~~ additional energy for stripping operation, do not arise.

\_\_\_\_\_ This object is basically achieved by a filter element ~~with the features specified in claim 1 in its entirety~~.

\_\_\_\_\_ In that, ~~as specified in the characterizing part of claim 1, where~~ the stripping means is ~~formed from~~ includes a stripping ring ~~which as it moves~~ movable along the rod-shaped magnet ~~removes to remove~~ the portions which are held by the capture device ~~and when~~. When the filtration part is being backflushed, the stripping ring is moved by the fluid flow ~~effects stripping of and strips~~ the portions which have been ~~fixed~~ attached on the capture device, ~~it is ensured that the~~. The magnetizable, especially ferritic portion component of the contaminants ~~which are to be filtered out of the fluid, which component adversely affects the filtration performance and the filter element material, cannot reach the filtration part with its selective filter material at all, but~~. Rather, the ferritic portion is separated beforehand in significant parts from the fluid flow. This separation takes place by capturing the magnetizable, especially ferritic portions, in a very effective manner even if these portions comprise a large part of the contaminants in the fluid which is to be filtered. Furthermore, the selectivity of the filtration part with its filter material can be oriented to the contaminants ~~which are to be conventionally expected, so that no special, especially costly adaptations are necessary here, but rather~~. Rather, the filtration part can be selected within ~~the framework of what is conventional, and by~~ framework. By way of the capture device, it is ensured that the selective material does not come into contact at all with the magnetizable contamination portions to any significant extent. Accordingly, the filter element design ~~as claimed in the~~ of the present invention can also be implemented especially cost-effectively and thus economically.

~~The stripping means as claimed in~~As the invention is formed from a stripping ring which,  
~~as it moves along the rod-like magnet, the ring effects removal of the fluid portions which have~~  
~~been captured by the capture device.~~ The stripping ring is positioned in normal filtration  
operation, preferably in the end area of the magnet, and in this way allows collection of the  
magnetizable material on the magnet. For any backflushing of the filter element in ~~which the~~  
throughflow direction becomes reversed and fluid flows through the filtration part from the clean  
side in the opposite direction, the cleaned fluid flow entrains the stripping ring ~~which then~~  
automatically cleans the captured magnetizable material off the rod-shaped magnet, ~~and on.~~ On  
the pertinent magnetizable parts, other contaminant portions can be taken up at the same time, and  
are likewise stripped in this way.

If the magnet is formed from an electromagnet, the stripping can be further promoted by  
the de-energized state of the pertinent magnet ~~and possible.~~ Possible remanence properties can be  
achieved by reversing the poles of the field of the respective electromagnet being used.

~~It is provided in~~In an especially advantageous manner ~~that,~~ the filter element with its  
filtration part is made conical ~~and that,~~ with the structural length of the element ~~is being~~ at least  
ten times greater than the largest existing passage cross section for the fluid. ~~It has been shown~~  
~~that due~~ Due to the described flow conditions in the conical filter element, this flow promotes the  
deposition of magnetizable material on the capture device, ~~the.~~ The jacket structure of the  
captured magnetizable, especially ferritic material on the capture device ~~following follows the~~  
conical jacket configuration of the filter element, ~~so that the.~~ The deposits on the capture device  
do not adversely affect the free flow cross section within the filter element to any significant  
degree because the free fluid flow paths remain constant in diameter over the length of the capture  
device. Conversely, it is found that due to the favorable flow conditions during backflushing with  
the conical filter element, it is sufficient if the capture device extends along half the filtration part  
on which the fluid enters and where the greatest passage cross section for the fluid flow exists.



~~The described~~ This configuration can however also be easily used for cylindrical filter elements, and the filtration part can be made in the manner of a slotted hole screen tube; ~~but it.~~ It can also be a conventional, even an unfolded filter material in the form of a filter mat or the like.

~~— The filter element as claimed in the invention is detailed below using one embodiment as shown in the drawings. The figures are~~

~~Other objects, advantages and salient features of the present invention will become apparent from the following detailed description, which, taken in conjunction with the annexed drawings, discloses preferred embodiments of the present invention.~~

#### Brief Description of the Drawings

~~Referring to the drawings which form a part of this disclosure:~~

FIG. 1a is a schematic and not to scale.

~~FIG. 1a shows in a, partial cutaway-a, side elevational view of the-a filter element in the form of a slotted hole screen tubular filter element without the magnet capture device, according to an embodiment of the present invention;~~

~~FIG. 1b — shows a section is an end elevational view in section taken along line I-I in of FIG. 1a;~~

~~FIG. 1c — shows in is an enlarged representation-a partial side elevational view of a detail designated as "X" in FIG. 1a;~~

~~FIG. 2—shows a longitudinal-2 is a side elevational view in section through a backflush filter device with cylindrical and tapering filter elements;, according to an embodiment of the present invention; and~~

FIG. 3 ~~shows, viewed is a partial, side elevational view, partially in a front view, partially in a longitudinal section, a side view with~~ of the internal structure of the filter element as shown in of FIG. 1a, ~~in and FIG. 32 with~~ the filter material being shown only schematically and not in detail.

#### Detailed Description of the Invention

The slotted hole screen tubular filter element 8 shown in FIG. 1 ~~in~~ has a side view in the direction of its longitudinal axis 10 ~~has and~~ support rods 12 tilted toward it, ~~around which the axis.~~ Around the support rods, a wire profile 16 is wound in individual turns 18, leaving gaps 14 through which the fluid can pass, ~~in.~~ In the area of each contact point of the wire profile 16 with the support rod 12 ~~there being, a weld is provided.~~ The gap size ~~which is~~ provided for free fluid passage, therefore the distance between two ~~gaps 14~~ wire turns 18, is shown in FIG. 1c with arrows 20 which face one another.

As furthermore shown especially by FIG. 1a, the respective support rod 12 with its one end 22 is tilted toward the longitudinal axis 10 such that an overall tapering filter element 8 is formed, with the turns 18 of the wire profile 16 decreasing in diameter in the direction of the tilted ends 22 of the support rods 12; ~~this.~~ This arrangement is also apparent from FIG. 1b. Instead of a single wire profile 16, as shown in the figures, optionally several successive wire profiles or wire profiles wound and located on top of one another (not shown) can also be used, if this is necessary for the indicated filtration task. The length L of the slotted hole screen tubular filter element 8 measured in the direction of the longitudinal axis 10 is approximately 11 times greater than the greatest existing passage cross section D for the fluid on the end of the filter element 8 ~~which is~~ the right ~~end as viewed in the direction of looking at~~ FIG. 1a.

The support rods 12 and the wire profile 16 ~~consist are made~~ of high-grade steel, with the support rods 12 being square in cross section and with the wire profile 16 being triangular. The gap widths ~~which are to be selected and which are~~ identified with the double arrow 20 in FIG. 1c

can be matched to the size of the solid portions to be filtered out of the fluid, especially in the form of hydraulic oil, ~~the~~. ~~The~~ filtered fluid ~~passing~~passes freely through the gaps 14 ~~and the~~. ~~The~~ solid portions or dirt portions ~~which~~ have been filtered out and retained by the turns 18 of the wire profile 16 remaining within the filter element 8 or ~~settling~~ partially in the gaps 14, ~~with the~~. ~~As a result that as of using~~ the slotted hole screen tubular filter element 8 ~~is used~~ for a longer and longer time, it becomes increasingly clogged and can no longer be used for filtration. In the pertinent case, in the reversed fluid passage direction the filter element 8 can be cleaned out by backflushing. In FIG. 1a in a schematic view, the direction of filtration from the inside to the outside is identified with an arrow 24, and the opposite direction of backflushing is designated with an arrow 26. For the sake of simpler representation the magnet capture device ~~as claimed in~~ the of the present invention is not shown in FIGS. 1a, b, c.

The operation and use of the above described slotted hole screen tubular filter element using a backflushing filter device as shown in FIG. 2 are explained below.

The backflushing filter device shown in FIG. 2 has a cylindrical housing 30 with sealing covers 32, 34 ~~which can be~~ fixed on the filter housing 30 by ~~way of~~ flange connections 36. The housing 10 of the backflushing device has a filter inlet 38 for the fluid ~~which is~~ to be filtered and a filter outlet 40 for the filtered fluid. The fluid direction in filtering operation through the housing 30 is indicated in FIG. 2 with the corresponding ~~arrow~~ arrows at the filter inlet 38 and filter outlet 40. In addition to the conical filter elements 8 ~~which are~~ located on the left when viewed in the direction of looking at FIG. 2, cylindrical filter elements 42 are also used. Both the conical slotted hole screen tubular filter element 8 and ~~also the~~ cylindrical slotted hole screen tubular filter element 42, are divided into groups at distances from one another, and are configured in a plurality along cylindrical arcs within the filter housing 30. All the filter elements shown in FIG. 2 discharge or open with their inlet cross section D, that is to say, with their free opening, into cylindrical recesses 44 of the lower sealing cover 34. On its opposite end which is the respective other end, ~~the each~~ conical ~~and or~~ cylindrical filter elements ~~8 element 8~~ and 42 ~~which are being~~

~~used are~~ is provided with sealing caps 46 with which each end of a wire profile 16 is welded ~~and by way of which.~~ By the sealing caps, the filter elements are held on a plate-shaped intermediate piece 48 against ~~which~~ the upper sealing cover 32 abuts from the top.

For the actual backflushing of the backflushing filter device ~~there is~~, a drivable flushing arm 50 ~~which has~~, on its bottom ~~provides~~, a connection in the form of a fluid outlet 52 for fouled fluid. The flushing arm 50 ~~which has~~ two different arm segments 54 ~~in its length can be moved~~ movable by way of a drive rod 56 in succession ~~to~~ under the passage cross sections D of the conical and cylindrical filter elements 8 and 42. Therefore, backflushing takes place continuously with the actual filtration process, with only the selected filter elements 8, 42 being backflushed, from the outside to the inside, with the cleaned, filtered fluid ~~which is~~ formed during filtration with the other filter elements, ~~with the.~~ The arm sections 54 of the flushing arm 50 extending under ~~their~~ the respective free passage cross sections D. To drive the drive rod 56, especially in the form of a hollow shaft, on the top sealing cover 32 there is a spline shaft connection 60 by ~~way of~~ which the drive rod can be driven with the motor or the like for rotational revolution around the longitudinal axis 56.

As shown by FIG. 3 using a conical element 8, ~~there is~~ a capture device ~~which is designated as a whole as 62,~~ is provided which at least partially removes magnetizable, especially ferritic portions (not shown) from the fluid, before it flows through the filtration part in the form of slotted hole screen tubular filter material in the direction of the arrow 24 from the inside to the outside. In the embodiment as shown in FIG. 3, the capture device 62 has a permanent magnet 64 which attracts the magnetizable, especially ferritic fluid portions, for example from a cooling lubricant flow to be filtered, ~~which.~~ The portions then settle on the permanent magnet 64 on its outer circumferential side. The cooling lubricant flow from which especially the ferritic fluid portions have been removed is then further filtered by the slotted hole screen tubular filter material as the filtration part and the pertinent contaminants are retained by the ~~clean side of the~~ filter device.

As FIG. 3 furthermore shows, the permanent magnet 64 in the form of a rod extends along the longitudinal axis of the conical filter element 8. This magnet ~~moreover~~ has a cylindrical outside circumferential surface so that on the inside the conical inflow space 66 is retained for the conical filter element. Instead of an individual permanent magnet 64, a plurality of individual magnets can comprise the pertinent permanent magnets (not detailed).

Furthermore, instead of the permanent magnet 64, an electromagnet of conventional design can also be used. ~~Furthermore, the~~ The capture device 62 for the magnetizable, especially ferritic fluid portions has a stripping means ~~designated as a whole as~~ 68 for removing the indicated portions from the capture device 62. The stripping means 68 ~~consists of~~ includes a stripping ring 70 which removes the ferritic fluid portions which have been caught by the capture device 62 as it moves along the rod-shaped permanent magnet 64. The stripping ring 70 encloses the outer circumferential surface of the rod-shaped permanent magnet 64 with a definable radial play ~~which allows~~ allowing the stripping ring 70 to move unobstructed along the outside contour of the magnet 64. To limit the free path of motion along the magnet 64, on ~~it~~ two stops 72 are provided; ~~and~~. As viewed in the direction of looking at FIG. 3, the stripping ring 70 is in its bottom end position in which it has been moved against the lower stop 72.

This position corresponds to the backflushing position in which, by the fluid backflushing opposite the direction of the arrows 24, the clean flow originating from the other filter elements in conventional filtration operation resets the stripping ring 70 out of its uppermost end position in which it has moved against the upper stop 72, into its bottom stop position for cleaning off the magnet means. In the incident flow direction shown in FIG. 3 by ~~way of~~ the arrows 24 ~~which corresponds~~ corresponding to conventional filtration operation of this filter element, the stripping ring 70 would accordingly be moved out of its position shown in FIG. 3 to the top again against the upper stop 72. Based on the already described throughflow conditions in the conical filter element, the permanent magnet 64 is located only over a length within the filter element ~~which is~~

smaller than half the pertinent filter element ~~length~~. To hold the permanent magnet 64, a magnet rod receptacle or receiver 74 is used which, likewise made rod-like, on its bottom end carries the permanent magnet over a screw section 76 ~~and on~~. On the top end, the magnet rod receiver 74 is fixed with a conventional hexagonal screw 78 on the top end of the conical filter element ~~which~~ terminates in the end plate 80.

The ~~described~~ capture device 62 with the permanent magnet 64 can also be used for a cylindrical filter element, ~~and then optionally~~. Optionally, the magnet section can be enlarged over half the length of the filter element. For the conical filter element, it has ~~however~~ been found that in a backflushing process the removal of the ferritic material from the permanent magnet 64 is also supported, so that a possibly stubborn build-up of ferritic material can also be cleaned off in this way.

Furthermore, the ~~solution as claimed in the present~~ invention need not be limited to filter elements in slotted hole screen tubular form, ~~but rather also other~~. Other element shapes with other filter materials, for example with a conventional filter mat structure, can be kept free of ferritic portions in the selective material in this way.

While various embodiments have been chosen to illustrate the invention, it will be understood by those skilled in the art that various changes and modifications can be made therein without departing from the scope of the invention as defined in the appended claims.  
What is claimed is:

## FILTER ELEMENT

### Abstract of the Disclosure

A filter element (8), especially for use in backwash filtering systems, includes a filtering element through which a contaminated fluid flows in at least one direction (24). An intercepting device (62) has at least one rod-shaped permanent magnet or electromagnet (64) that at least partially removes magnetizable, especially ferritic portions from the fluid, before the fluid flows through the filtering element. A detaching device (68) removes the magnetizable portions from the intercepting device (62). The detaching device (68) is configured by a stripper ring (70) that travels along the rod-shaped magnet (64) and removes the portions retained by the intercepting device (62). When the filtering element is backwashed, the stripper ring (70), moved by the fluid flow, detaches the portions retained by the intercepting device (62). This filter element requires little construction space and allows for the automatic and energetically favorable removal of magnetizable, especially ferritic portions, when the filtering element is backwashed.